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Best Demonstrated Available Technology (BDAT) Background Document for Inorganic Pigment Wastes (K002, K003, K005, K006, and K007) (Proposed)

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PROPOSED

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

BACKGROUND DOCUMENT FOR

Inorganic Pigment Wastes

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TABLE OF CONTENTS

Section			Page
1.	INTRODUCTION		1-1
2.	INDUSTRIES AFFECTED AND WASTE CHARACTERIZATION		2-1
	2.1	Industry Affected and Process Description	2-1
	2.2	Waste Characterization	2-13
	2.3	Determination of Waste Treatability Group	2-13
3.	APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES		3-1
	3.1	Applicable Treatment Technologies	3-1
	3.2	Demonstrated Treatment Technologies	3-2
4.	PERFORMANCE DATA BASE		4-1
5.	IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)		5-1
6.	SELECTION OF REGULATED CONSTITUENTS		6-1
7.	DEVELOPMENT OF BDAT TREATMENT STANDARDS		7-1
8.	REFERENCES		8-1

LIST OF TABLES

Table		Page
2-1	Present Chrome Pigments Manufacturers That Generate K002, K003, and K006 Wastes	2-3
2-2	Chrome Pigment Manufacturers That Recycle Wastes or Wastewaters or Discharge Untreated Wastewaters to POTW Systems	2-4
2-3	BDAT Metals Concentrations for the Chromate and the Carbonate Sludge Samples	2-14
2-4	Estimated Composition of Wastewater Treatment Sludges from Inorganic Pigments Manufacturing Processes.....	2-15
4-1	BDAT TCLP Metal Values for Untreated Inorganic Pigment Sludges.....	4-3
4-2	TCLP Analytical Results for the Treated (Stabilized) Combined Wastewater Treatment Sludge Samples K002/K003/K004	4-4

LIST OF FIGURES

Figure		Page
2-1	Chrome Yellow Manufacture	2-6
2-2	Molybdate Orange Manufacture	2-8
2-3	Hydrated Chrome Oxide Green Manufacture by the Ammonium Dichromate Process	2-11
2-4	Hydrated Chrome Oxide Green Manufacture by the Boric Acid Process	2-12

1. INTRODUCTION

Pursuant to section 3004(m) of the Hazardous and Solid Waste Amendments (HSWA) enacted on November 8, 1984, the Environmental Protection Agency (EPA) is establishing treatment standards based on the best demonstrated available technology (BDAT) for inorganic pigment wastes. These wastes are identified in 40 CFR 261.32 as K002, K003, K005, K006, and K007. The wastes K004 and K008 were included in the first thirds list of wastes, treatment standards for these were promulgated on August 7, 1988. Compliance with these treatment standards is a prerequisite for placement of these wastes in facilities designated as land disposal units according to 40 CFR Part 268. The effective date of these treatment standards is June 8, 1989.

This background document presents the Agency's technical support and rationale for developing regulatory standards for these wastes. Sections 2 through 7 present waste-specific information for the K002, K003, K005, K006, and K007 wastes. Section 2 presents the number and location of facilities affected by the land disposal restrictions, the waste generating process, and waste characterization data. Section 3 discusses the technologies used to treat the waste (or similar wastes), and Section 4 presents available performance data, including data on which treatment standards are based. Section 5 explains EPA's determination of BDAT, while Section 6 discusses the selection of constituents to be regulated. Proposed treatment standards are determined in Section 7.

The BDAT program and promulgated methodology are more thoroughly described in two additional documents: Methodology for Developing BDAT Treatment Standards (USEPA 1988c) and Generic Quality Assurance Project Plan for Land Disposal Restrictions Program ("BDAT") (USEPA 1988b). The petition process to be followed in requesting a variance from the BDAT treatment standards is discussed in the methodology document.

It is EPA's understanding that only three facilities presently generate K002, K003, and K006 (chrome pigment wastes) as defined. These wastes are the wastewater treatment sludges from the production of chrome inorganic pigments and for the purpose of BDAT are nonwastewaters. [A wastewater is defined by the Agency as containing less than 1 percent (weight basis) total suspended solids* and less than 1 percent (weight basis) total organic carbon (TOC). Wastes not meeting this definition must comply with the treatment standards for nonwastewaters.] Six facilities, however, manufacture chrome inorganic pigments but do not generate a listed waste because they either recycle all process waters and solids or discharge the untreated wastewaters to publicly owned treatment works (POTWs). In addition, the Agency believes that the last company producing K005 and K007 ended production of the pigments from which these wastes were generated in June 1987.

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* The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, the quantity of total suspended solids is measured by Method 209c (Total Suspended Solids Dried at 103 to 105°C) in Standard Methods for the Examination of Water and Wastewater, 16th Edition. (APHA, AWWA, and WPCF 1985.)

The proposed treatment standard for K002, K003, and K006 is no land disposal, based on total reuse/recycle. The Agency believes reuse/recycle technologies have been demonstrated for these wastes. No land disposal is also the proposed standard for K005 and K007, since these wastes are no longer generated.

However, the Agency is proposing that these "No Land Disposal" treatment standards, whether based on recycling or no generation, apply only to K002, K003, K005, K006, and K007 nonwastewaters as generated (i.e., those wastes as defined in the original listing), and not to nonwastewater residues that may be potentially generated from management of wastes (i.e., "derived-from" nonwastewaters) generated prior to promulgation of the "No Land Disposal" standards.

2. INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

Wastes listed as K002, K003, K005, K006, and K007 are generated as the wastewater treatment sludges from the production of inorganic pigments. Under 40 CFR 261.32 wastes identified as K002, K003, K005, K006, and K007 are specifically listed as follows:

K002: Wastewater treatment sludge from the production of chrome yellow and orange pigments.

K003: Wastewater treatment sludge from the production of molybdate orange pigments.

K005: Wastewater treatment sludge from the production of chrome green pigments.

K006: Wastewater treatment sludge from the production of chrome oxide green pigments. (anhydrous and hydrated)

K007: Wastewater treatment sludge from the production of iron blue pigments.

The Agency has determined that these listed wastes represent a single treatability group based on their similar physical and chemical characteristics. As described later in this section, EPA has examined the sources of the wastes, the specific similarities in the waste composition, applicable and demonstrated treatment technologies, and attainable treatment performance in order to support a simplified regulatory approach for these five inorganic wastes.

2.1 Industry Affected and Process Description

The four-digit Standard Industrial Classification (SIC) code associated with the production of inorganic pigments is 2816. These pigments are used extensively in paints, printing ink, floor covering

products, and paper. In addition, they may also be used in ceramics, cement, and asphalt roofing.

The Agency believes that there are two facilities that generate both K002, and K003, and one facility that generates K006. It is the Agency's understanding that the chrome oxide green manufacturing facility (which generates K006) produces only hydrated chrome oxide green; anhydrous chrome oxide green is no longer manufactured.* Based on available information, the Agency also believes that the last company in the United States to generate K005 and K007 ended production in June 1987. Table 2-1 lists the names and locations of the current generators of K002, K003 and K006, the treatment and disposal methods used at these facilities, and the approximate product production levels achieved.

The Agency also identified those facilities that manufacture inorganic pigments but do not generate wastewater treatment sludges. These six facilities either discharge their untreated wastewaters to an NPDES regulated system or recycle their solids by blending them with product for subsequent sale. Table 2-2 identifies these facilities.

Below are descriptions of the five pigment manufacturing processes that EPA identified as generating K002, K003, K005, K006, and K007.

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* Two facilities currently manufacture hydrated chrome oxide green; however, one plant internally recycles all wastes. Neither facility generates any K008 wastes.

Table 2-1 Present Chrome Pigments Manufacturers that Generate K002, K003, and K006 Wastes

Plant	Location	Products Manufactured: Chrome yellow	Products Manufactured: Molybdate orange	Products Manufactured: Chrome oxide green	Total product production volumes	Wastes Generated
Pfizer	Lehigh Gap, PA			X(2)	B	K006
Harshaw Filtrol	Louisville, KY	X(2)	X(2)		A	K002, K003
Heubach	Newark, NJ	X(1)	X(1)		A	K002, K003

(1) Listed waste generated and sold for feedstock to lead smelter.
(2) Listed waste generated and land disposed offsite.

Reference: 3007 Questionnaire responses and telephone conversations with facilities to clarify responses (10/87 - 1/88).

A = >5,000 TPY
B = <5,000 TPY

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Table 2-2 Chrome Pigment Manufacturers That Recycle Wastes or Wastewaters or Discharge Untreated Wastewaters to POTW Systems

Plant	Location	Chrome yellow and orange	Molybdate orange	Chrome oxide green	Zinc yellow	Reason for no waste generation
NJZ Colors	Brooklyn, NY	X	X			Discharge to POTW.
KiKuchi Color	Patterson, NJ	X				Discharge to POTW.
American Chrome and Chemical	Corpus Christi, TX			X		Total reuse of waste generated.
NL Chemicals	St. Louis, MO	X				Total process water recycle.
Wayne Pigments	Milwaukee, WI	X	X			Discharge to POTW.
Mineral Pigments	Beltsville, MD				X	Consumptive use of wastewater to produce a byproduct.

Reference: 3007 Questionnaire responses and telephone conversations with facilities to clarify responses (10/87 - 1/88)

K002 - *Wastewater treatment sludges from the production of chrome yellow and orange pigments*

Chrome yellow and orange pigments (lead chromate) are produced by reacting sodium dichromate, caustic soda, and lead nitrate as follows. First, lead oxide or elemental lead is dissolved in nitric acid to generate a lead nitrate solution. This solution is then mixed with an alkaline solution of sodium dichromate. The reaction that occurs may be written as follows:

$$Na_2Cr_2O_7 + 2NaOH + 2Pb(NO_3)_2 - 2PbCrO_4 + 4NaNO_3 + H_2O.$$

Lead chromate (a hexavalent species) is formed as a precipitate and is recovered by filtration, then washed, dried, milled, and packaged. The filtrate and washwaters, containing lead and hexavalent chromium compounds, are sent to a wastewater treatment facility. Figure 2-1 presents a general schematic of a typical lead chromate production and waste treatment process.

K003 - *Wastewater treatment sludges from the production of molybdate orange pigments*

Molybdate orange pigment is made by the coprecipitation of lead chromate ($PbCrO_4$) and lead molybdate ($PbMoO_4$). Molybdic oxide is first dissolved in aqueous sodium hydroxide, then sodium chromate is added. This solution is mixed with a solution of lead oxide in nitric acid. The product, a mixture of lead chromate and lead molybdate precipitates from solution.

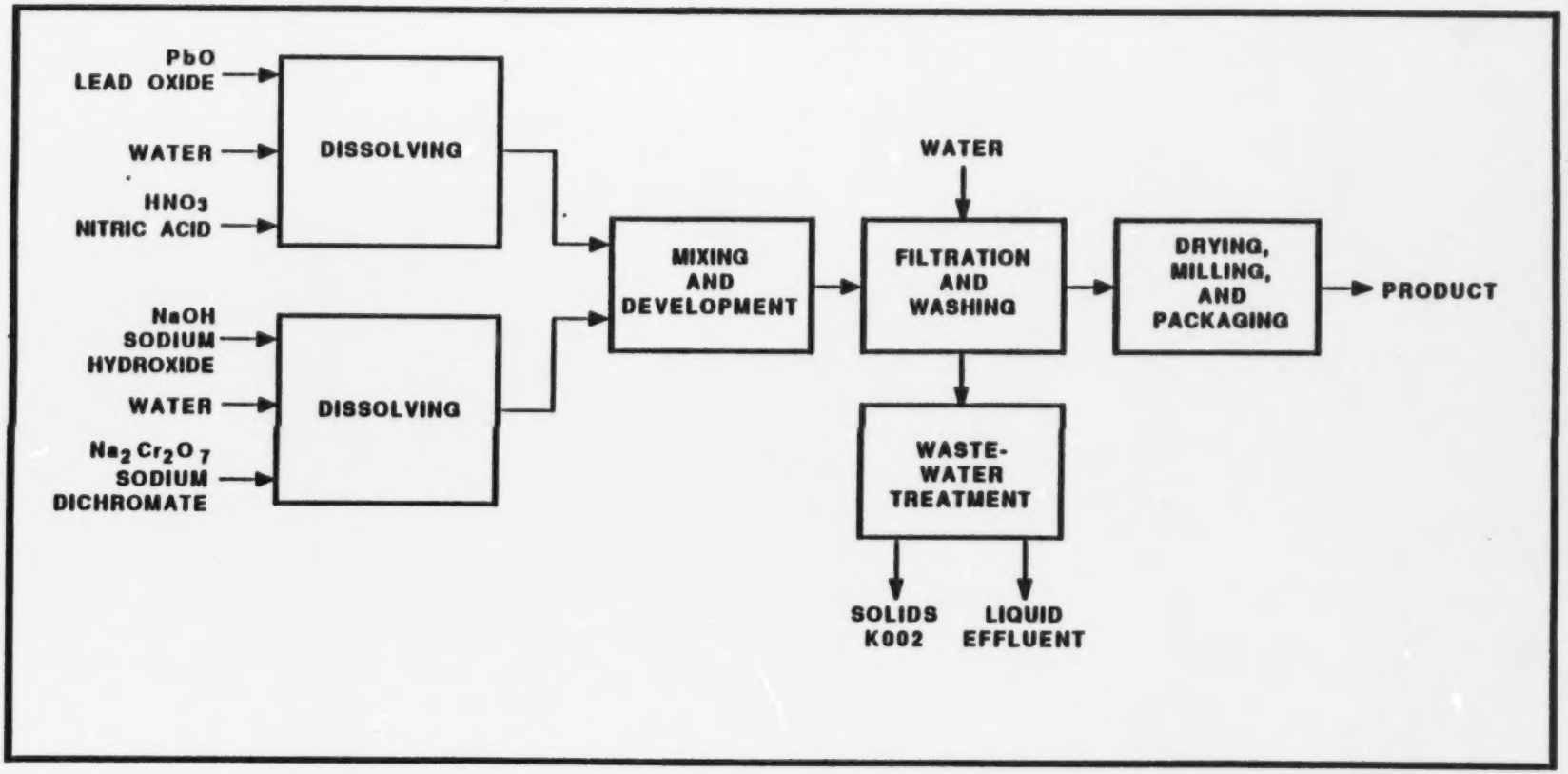

FIGURE 2-1 CHROME YELLOW MANUFACTURE

The precipitate (lead chromate and molybdate) is collected by filtration, washed, dried, milled, and packaged. The filtrate contains unreacted sodium chromate and sodium molybdate, lead ions, and some suspended particulates of unrecovered products. This wastewater stream is usually sent to a wastewater treatment facility. The wastewater treatment sludge produced in the listed waste K003. Figure 2-2 presents a general schematic of a typical molybdate orange production and waste treatment process.

K005 - *Wastewater treatment sludges from the production of chrome green pigments*

Chrome green pigments are no longer manufactured in the United States. These pigments are mixtures of chrome yellow and iron blue (iron ferrocyanide). They include a wide variety of hues, from very light to very dark green. Chrome green is produced by mechanically mixing aqueous dispersions of chrome yellow and iron blue pigments.

The resulting pigment suspensions are then filtered, dried, ground, blended, and packaged. When the sole facility producing chrome green was operating, the filtrate, which contains unrecovered particulates of chrome yellow and iron blue pigments, was sent to wastewater treatment for removal of suspended particulates prior to release under NPDES permit. This production facility closed permanently in 1987.

K006 - *Wastewater treatment sludges from the production of anhydrous and hydrated chrome oxide green pigments*

Hydrated chrome oxide green is produced at two facilities by different processes.

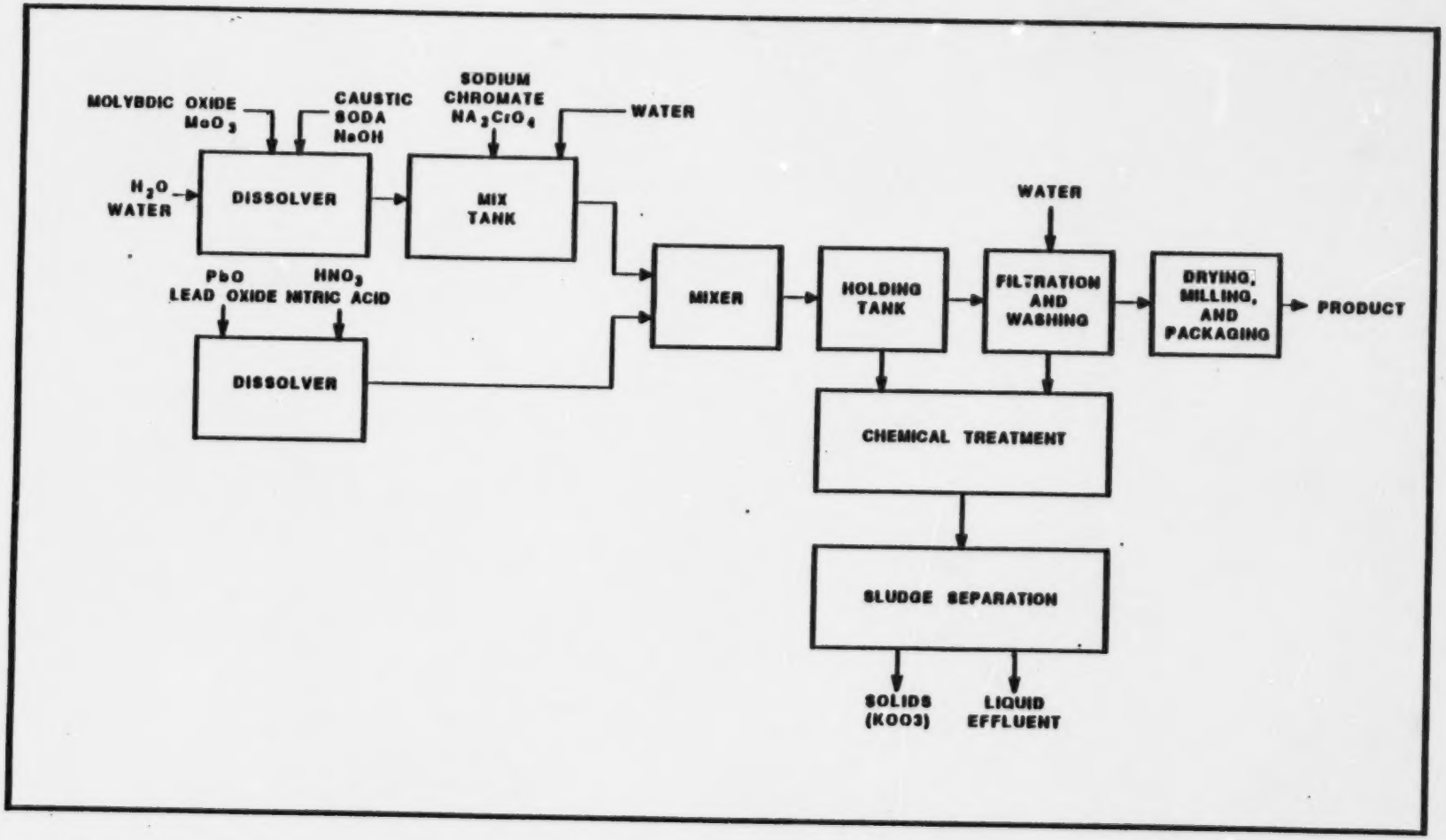

FIGURE 2-2 MOLYBDATE ORANGE MANUFACTURE

The first process employs the thermal decomposition of ammonium dichromate. Sodium dichromate solution and ammonium sulfate are mixed together; this mixing results in a solid mass consisting of ammonium dichromate and sodium sulfate decahydrate ($Na_2SO_4 \cdot 10H_2O$).

This mixture is then heated in a kiln to a temperature above 500°C. The ammonium dichromate decomposes according to the reaction:

(a) $(NH_4)_2\ Cr_2O_7 \rightarrow Cr_2O_3 + N_2 + 4H_2O$

(b) $Cr_2O_3 + 2H_2O \rightarrow Cr_2O_3 \cdot 2H_2O$ (hydrated chrome oxide green).

The reacted material is recovered from the kiln and leached with water. The sodium sulfate dissolves out of the product mass, and the leached product is then recovered by filtration, washed, dried, and packaged. The sodium sulfate-containing wastewater is treated to reduce any hexavalent chromium compounds present and then is filtered prior to discharge. The K006 waste stream is the filter cake generated from this process, which is collected, reclaimed in a second calciner, and blended with the product.

Anhydrous chrome oxide green can also be manufactured via this process by operating the reaction kilns at higher temperatures.

In the second process for manufacture of hydrated chrome oxide green, sodium dichromate is reacted with boric acid as follows:

$$2Na_2Cr_2O_7 + 8H_3BO_3 \rightarrow 2Cr_2O_3 \cdot 2H_2O + 2Na_2B_4O_7 + 3O_2$$

The raw materials are blended in a mixer, then heated in an oven at 550°C. Oven residues which contain hexavalent and trivalent chromium, are washed out of the oven and sent to a boric acid recovery

recovery unit. The reacted material is slurried with water and filtered. The filtered solids are washed, dried, ground, screened, and packaged. The filtrate and washwater are also treated to recover the boric acid. The waste stream from the boric acid recovery unit, containing a hexavalent chromium compound, is sent to wastewater treatment where chemical treatment of the wastewater with sodium bisulfite followed by filtration generates the listed waste K006. Figures 2-3 and 2-4 present schematics of the two types of hydrated chrome oxide green manufacturing and waste treatment processes.

Anhydrous chrome oxide, a trivalent chromium pigment, is no longer produced in the United States. In the past, it was manufactured by the calcination of sodium dichromate, a hexavalent chromate, with sulfur and/or carbon, flour, or other organic matter. In cases where sulfur is used, the reaction may be written as:

$$Na_2Cr_2O_7 + S \xrightarrow{\Delta} Na_2SO_4 + Cr_2O_3.$$

In cases where carbon or flour was used, sodium carbonate was generated as the coproduct in place of sodium sulfate.

The trivalent chromium oxide thus formed was slurried with water, filtered, washed, dried, and packaged. The filtrate and washwater, which contained some unreacted hexavalent chromium materials, were sent to wastewater treatment.

K007 - *Wastewater treatment sludges from the production of iron blue pigments*

Iron blue pigments are produced by the reaction of sodium ferrocyanide with an aqueous solution of iron sulfate and ammonium

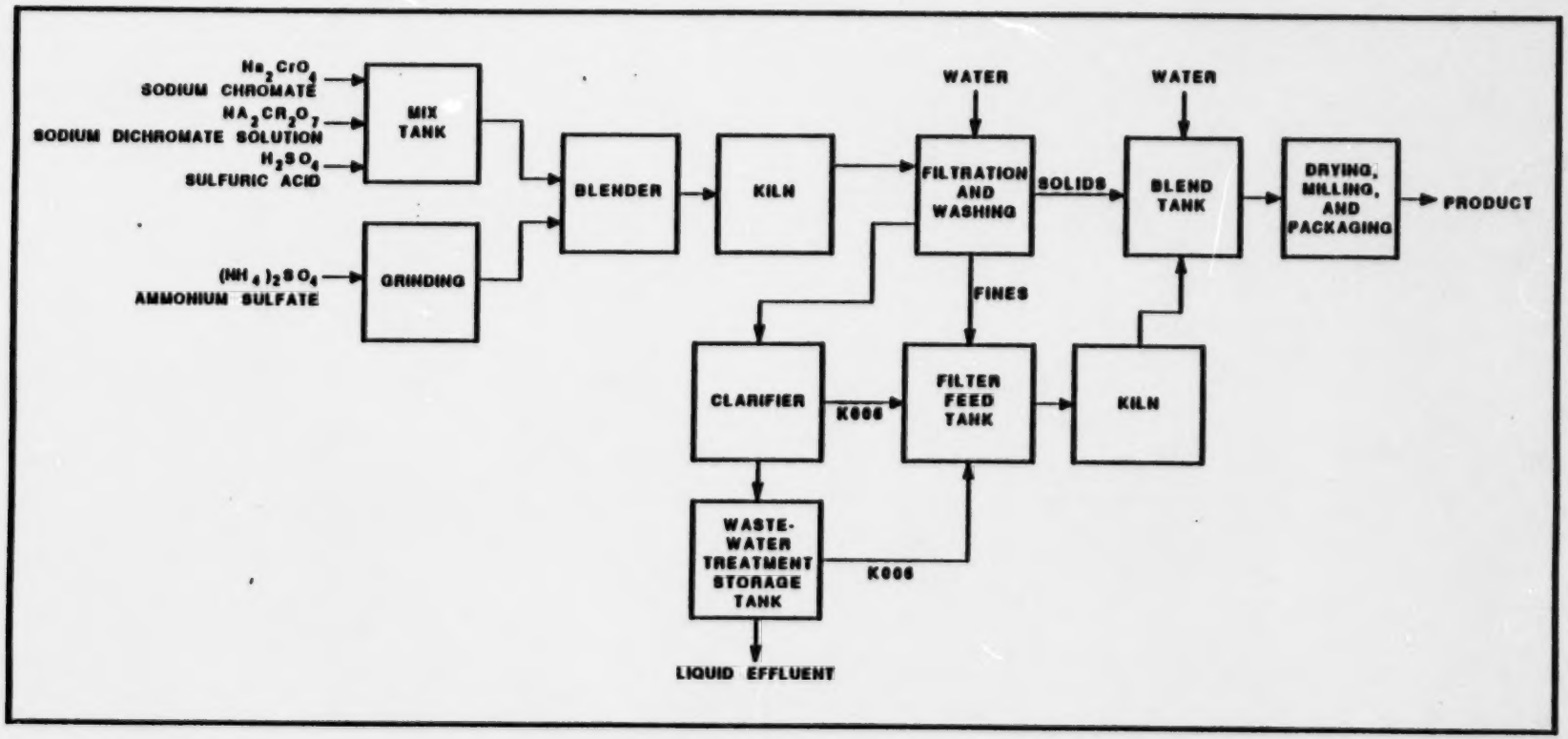

FIGURE 2-3 HYDRATED CHROME OXIDE GREEN MANUFACTURE BY THE AMMONIUM DICHROMATE PROCESS

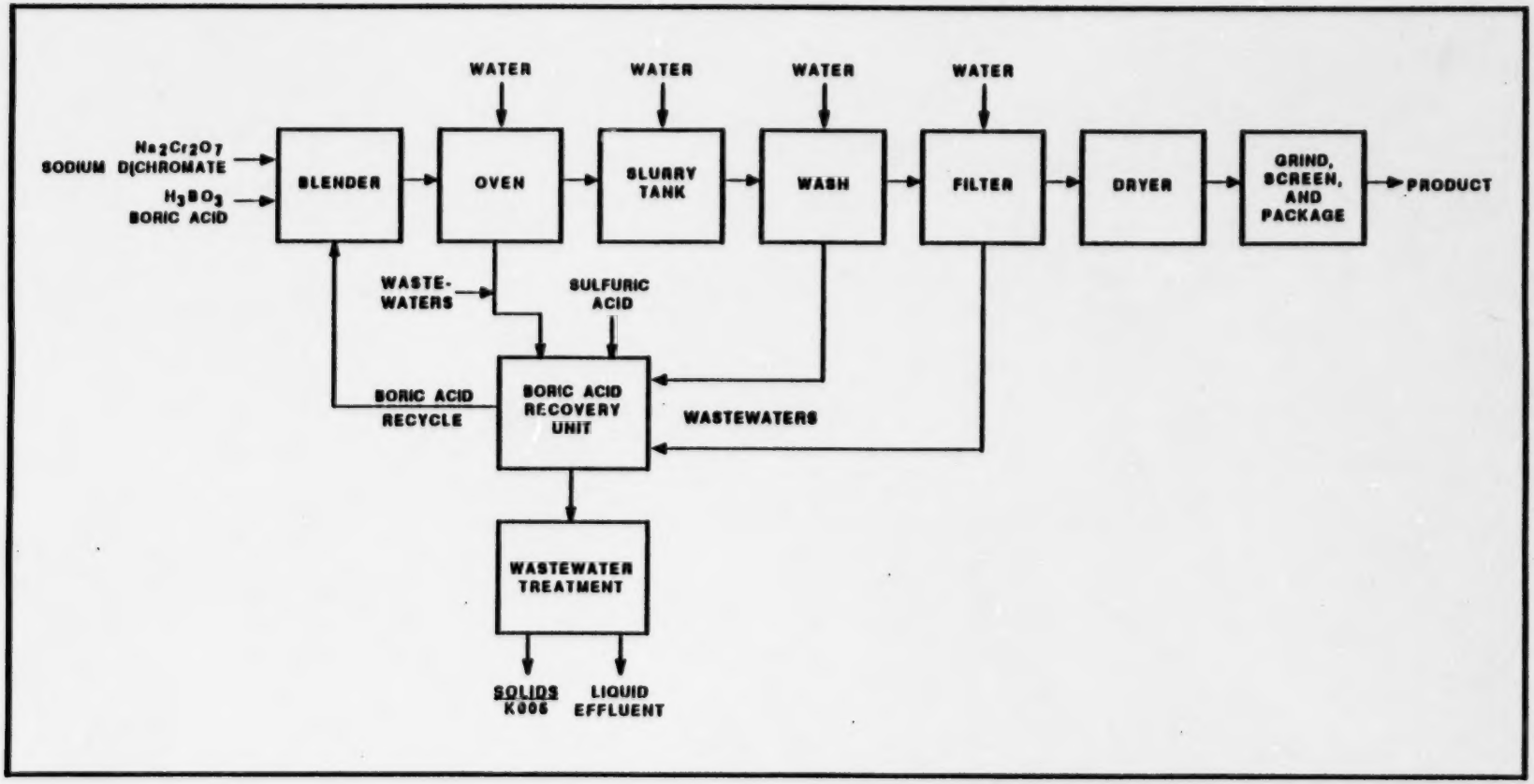

FIGURE 2-4 HYDRATED CHROME OXIDE GREEN MANUFACTURE BY THE BORIC ACID PROCESS

sulfate. The precipitate formed is separated and oxidized with sodium chlorate or sodium chromate, a hexavalent chromium compound, to form iron blues.

The final product was then collected by filtration, washed, dried, milled, and packaged.

The wastewaters contain all of the chemicals used in the process, along with some unrecovered product. Subsequent treatment of the wastewaters generates a sludge containing complex iron cyanides. EPA believes that the last facility producing iron blues in the United States closed permanently in June 1987.

2.2 Waste Characterization

Waste characterization data for waste codes K002, K003, K005, K006, and K007 that were available to the Agency are summarized below. Table 2-3 contains specific characterization data for waste codes K002, K003, and K004 from an onsite engineering study. Table 2-4 presents estimated general data for the major constituents in wastes K002, K003, K005, K006, and K007, along with their approximate concentrations from the original listing documents.

2.3 Determination of Waste Treatability Group

In some cases EPA believes that wastes with different waste codes produced in similar processes in an industry or in similar industries, can be treated to similar concentrations by using the same technologies. In these instances, the Agency may combine the codes into a single treatability group. Based on careful review of the generators of

Table 2-3 BDAT Metals Concentrations for the Chromate and the Carbonate Sludge Samples

BDAT constituent (ppm)	K002/K003 Yellow chromate sludge	Mixture of K002, K003, and K004 Carbonate sludge	K002/K003 Orange chromate sludge
Antimony	ND[d]	ND	ND
Arsenic	ND	ND	ND
Barium	530	ND	700
Beryllium	ND	ND	ND
Cadmium	ND	ND	ND
Chromium (T)	106,000	850	74,000
Copper	ND	ND	ND
Lead	670,000	750,000	610,000
Mercury	0.27	ND	ND
Nickel	ND	ND	ND
Selenium	ND	ND	ND
Silver	ND	ND	ND
Thallium	ND	ND	ND
Vanadium	ND	ND	ND
Zinc	290	85,000	710
Total Cyanide	ND	ND	ND
Sulfide	NA[e]	NA	ND
Other constituents	balance	balance	balance

ND = not detected
NA = Not analyzed.

Reference: USEPA 1987.

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Table 2-4 Estimated Composition of Wastewater Treatment Sludges from Inorganic Pigments Manufacturing Processes

Sludge source	Estimated contaminants in sludge
K002 Production of chrome yellow and orange pigments	30,000 ppm $PbCrO_4$ lead chromate 10,400 ppm $Cr(OH)_3$ chromium hydroxide 2,500 ppm $Pb(OH)_2$ lead hydroxide
K003 Production of molybdate orange pigments	20,000 ppm $PbCrO_4$ -$PbMoO_4$ (molybdate orange) 10,000 ppm $(Cr(OH)_3$ chromium hydroxide 2,500 ppm $Pb(OH)_2$ lead hydroxide
K005 Production of chrome green pigments	5,000 ppm $PbCrO_4Fe$ $(NH_4)[Fe(CN)_6]$
K006 Production of anhydrous chrome oxide green pigments	22,000 ppm $Cr(OH)_3$ chromium hydroxide
K006 Production of hydrated chrome oxide green pigments	66,000 ppm $Cr(OH)_3$ chromium hydroxide
K007 Production of iron blue pigments	25,000 ppm $Fe_4(Fe(CN)_6)_3$ ferric ferrocyanide

Reference: USEPA 1980a.

inorganic pigments and available waste characterization data, the Agency has determined that wastes K002, K003, and K006 represent a single treatability group. The concentration and type of metal constituents in the various wastes are dependent upon the waste type, the particular production process employed, and the specifics of the treatment process. However, all the wastes contain similar constituents and are expected to be treatable to similar levels by using the same technology.

With respect to wastes K005 and K007, EPA has determined that the pigments from which these wastes were generated are no longer produced in the United States. As a result, there is no need at this time to determine waste treatability groups, nor is it possible to evaluate treatment technologies.

3. APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

Section 2 established a single treatability group for the management of K002, K003, and K006 wastes. This section identifies the treatment technologies that are applicable to this group and determines which, if any, of the applicable technologies can be considered demonstrated for the purpose of establishing BDAT.

To be applicable, a technology must be theoretically usable to treat the waste in question or to treat a waste that is similar in terms of the parameters that affect treatment selection. (For detailed descriptions of the technologies applicable for these wastes, or for wastes judged to be similar, see EPA's Treatment Technology Background Document (USEPA 1988d).) To be demonstrated, the technology must be employed in full-scale operation for the treatment of the waste in question or a similar waste. Technologies available only at pilot- and bench-scale operations are <u>not</u> considered in identifying demonstrated technologies.

3.1 Applicable Treatment Technologies

Initial data gathering on the treatment of K002, K003, and K006 wastes included review of the technical literature, review of 3007 questionnaires, and contacts with industry representatives. As a result of these efforts, EPA has identified three technologies as potentially applicable for treatment of wastes K002, K003, and K006. These technologies are stabilization, high temperature metals recovery (HTMR), and reuse/recycle.

With respect to nonwastewaters, stabilization reduces the leachability of the metals, HTMR reduces both the total concentration and the leachability of the metals through the production of slag, and product reuse/recycle eliminates the waste stream entirely.

The Agency believes that stabilization may be used to treat K002, K003, and K006; this belief is based on the chemical and physical similarity of these wastes to F006 (wastewater treatment sludges from electroplating operations). Also, the Agency is of the opinion that HTMR may be used to treat K002, K003, and K006 because of the chemical and physical similarities of these wastes to K061 (electric arc furnace dust); all are solid wastes with a high metal content.

Stabilization and high temperature metals recovery are discussed fully in the F006 Background Document (USEPA 1988a) and in the Treatment Technology Background Document (USEPA 1988d). Product reuse/recycle involves the elimination of the nonwastewater streams by reuse in the manufacture of another product or recycle of all nonwastewater process residuals in the production cycle.

3.2 Demonstrated Treatment Technologies

Of the above-mentioned applicable technologies, all have been demonstrated on the pigment production wastes or similar wastes. Stabilization has been demonstrated on F006 wastes (wastewater treatment sludges from electroplating operations), and HTMR has been demonstrated on K061 (electric arc furnace dust), which, as previously mentioned, is similar to K002, K003, and K006. The Agency has identified a facility

that is practicing product reuse and recycle, in conjunction with HTMR, for a mixed K002/K003 waste, and also has stabilization data for this waste. In addition, the Agency is aware of a facility that recycles its solids (K006) resulting from the manufacture of chrome oxide green.

Product reuse/recycle of mixed K002/K003 involves the addition of lead salts to the process wastewater; the lead salts act as a precipitating agent and raise the lead content of the sludge. The sludge is subsequently sold to a primary lead smelter to be used as a feedstock substitute for the smelter's raw material (lead sulfide bearing ore). This sludge consists primarily of lead chromate and lead carbonate which are natural constituents of some lead ores.

According to information supplied to the Agency, the recycle of K006 nonwastewaters results in the reduction of BDAT metals in the wastewater residuals generated from the production of chrome oxide green. Solids from the wastewater treatment system are recycled back to the production process for inclusion in the finished product. The solids are chemically identical to the product chrome oxide green.

The Agency believes these reuse/recycle technologies are applicable and demonstrated and has no reason to believe that they cannot be successfully employed for all K002, K003, and K006 nonwastewaters.

4. PERFORMANCE DATA BASE

This section presents the data available to EPA on the performance of demonstrated technologies in treating the listed wastes. These data are used elsewhere in this document for determining which technologies represent BDAT (Section 5), for selecting constituents to be regulated (Section 6), and for developing treatment standards (Section 7). Eligible data, in addition to full-scale demonstration data, may include data developed at research facilities or obtained through other applications at less than full-scale operation, as long as the technology is demonstrated in full-scale operation for a similar waste or wastes as defined in Section 3.

Performance data, to the extent that they are available to EPA, include the untreated and treated waste concentrations for a given constituent, values of operating parameters that were measured at the time the waste was being treated, the values of relevant design parameters for the treatment technology, and data on waste characteristics that affect performance of the treatment technology.

Where data are not available on the treatment of the specific wastes of concern, the Agency may elect to transfer data on the treatment of a similar waste or wastes, using a demonstrated technology. To transfer data from another waste category, EPA must find that the wastes covered by this background document are no more difficult to treat (based on the waste characteristics that affect performance of the demonstrated

treatment technology) than the treated wastes from which performance data are being transferred.

The Agency has stabilization data for a mixed untreated and treated K002/K003/K004 waste. This waste was obtained from a facility that produced chrome yellow, molybdate orange, and zinc yellow pigments in 1985 and 1986. The facility phased out production of zinc yellow in early 1987, but still produces the other two pigments. The untreated leachate data are presented in Table 4-1 and the treated leachate data are presented in Table 4-2. The Agency does not have data on the residuals generated from primary lead smelting. However, because these wastes have a high lead content and do not contain hazardous constituents not found in lead-bearing ores, it expects that these wastes will be considered indigenous to primary lead smelting, and thus will be classified as being from the mining and beneficiation of ores and minerals. With respect to reuse/recycle, the Agency has documentation from three facilities recycling K002, K003, and/or K006 nonwastewaters. Based on this information, nonwastewater residuals, which would continue to be listed wastes, are not generated; with respect to reuse/recycle, the nonwastewater "treated" concentrations values are, in essence, zero.

Table 4-1 BDAT TCLP Metal Values for Untreated Inorganic Pigment Sludges

BDAT constituent	K002/K003 Yellow chromate sludge (ppm)	K002/K003/K004 Carbonate sludge (ppm)	K002/K003 Orange chromate sludge (ppm)
Arsenic	ND	ND	ND
Barium	ND	0.09	ND
Cadmium	ND	0.047	ND
Chromium (TOT)	1.2	1.3	2.7
Lead	320	5400	1600
Mercury	ND	ND	ND
Selenium	ND	ND	ND
Silver	ND	ND	ND

ND = None detected at practical quantitation limit.

Reference: USEPA 1987.

Table 4-2 TCLP Analytical Results for the Treated (Stabilized) Combined Wastewater Treatment Sludge Samples K002/K003/K004

	Treated waste (cement binder) TCLP sample number		
	A mg/l	B mg/l	C mg/l
Antimony	ND	ND	ND
Arsenic	ND	ND	ND
Barium	0.2	0.26	0.47
Beryllium	ND	ND	ND
Cadmium	ND	ND	ND
Chromium (Total)	9.9	1.9	ND
Copper	ND	ND	ND
Lead	0.13	0.16	1.34
Mercury	ND	ND	ND
Nickel	ND	ND	ND
Selenium	ND	ND	ND
Silver	ND	ND	ND
Thallium	ND	ND	ND
Vanadium	ND	ND	ND
Zinc	0.094	0.24	ND
Kiln Dust Binder			
Antimony	ND	ND	ND
Arsenic	ND	ND	ND
Barium	0.088	0.024	0.18
Beryllium	ND	ND	ND
Cadmium	ND	ND	ND
Chromium (Total)	39.1	1.6	ND
Copper	ND	ND	ND
Lead	6.6	13.5	1.5
Mercury	ND	ND	ND
Nickel	ND	ND	ND
Selenium	ND	ND	ND
Silver	ND	ND	ND
Thallium	ND	ND	ND
Vanadium	ND	ND	ND
Zinc	2.3	1.7	ND

A = 84% K002/K003, 16% K002/K003/K004
B = 84% K002/K003, 16% K002/K003/K004
C = 84% K002/K003, 16% K002/K003/K004
ND = Not detected

Reference: USEPA 1987

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Table 4-2 (continued)

	Treated waste (lime flyash binder)		
	TCLP sample number		
	A	B	C
	mg/l	mg/l	mg/l
Antimony	ND	ND	ND
Arsenic	ND	ND	ND
Barium	0.14	0.055	0.16
Beryllium	ND	ND	ND
Cadmium	ND	ND	ND
Chromium (Total)	45.4	4.5	ND
Copper	ND	ND	ND
Lead	6.3	14	73.4
Mercury	ND	ND	ND
Nickel	ND	ND	ND
Selenium	ND	ND	ND
Silver	ND	ND	ND
Thallium	ND	ND	ND
Vanadium	ND	ND	ND
Zinc	2.6	2.1	0.96

A = 84% K002/K003, 16% K002/K003/K004
B = 84% K003/K003, 16% K002/K003/K004
C = 84% K002/K003, 16% K002/K003/K004
ND = Not detected.

Reference: USEPA 1987

5. IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section presents the Agency's rationale for determining best demonstrated available technology (BDAT) for K002, K003, and K006 nonwastewaters and wastewaters. Because EPA believes that K005 and K007 are no longer generated, selection of BDAT for these waste streams is unnecessary. EPA notes, however, that this applies only to wastes from current management, and not to materials such as leachate, contaminated environmental media, or other residues derived from historic management of these wastes.

To determine BDAT, the Agency examines all available performance data on technologies that are identified as demonstrated to determine (using statistical techniques) whether one or more of the technologies performs significantly better than the others. The technology that performs best on a particular waste or waste treatability group is then evaluated to determine whether it is "available." To be available the tecnology must (1) be commercially available to any generator and (2) provide "substantial" treatment of the waste, as determined through evaluation of accuracy-adjusted data. In determining whether treatment is substantial, EPA may consider data on the performance of a waste similar to the waste in question provided that the similar waste is at least as difficult to treat. If the best technology is found to be not available, then the next best technology is evaluated, and so on.

The most desirable waste management technology is one that results in no residual streams or a residual stream with no hazardous properties. In this instance, product reuse/recycle eliminates the waste streams (K002, K003, and K006) entirely and is therefore the preferred management method. Of the three demonstrated technologies, HTMR, stabilization, and product reuse/recycle, only the last eliminates the waste stream entirely. Both HTMR and stabilization generate residuals. The HTMR residuals will contain much lower concentrations of toxic constituents than the listed waste. Likewise, stabilization generates a residual that requires land disposal and has not been reduced in volume or total mass of hazardous constituents. Based on the Agency's hierarchy of preference for waste management practices (USEPA, 1988c), the Agency has determined that product reuse/recycle of K002, K003, and K006 represents the best of the demonstrated technologies. Product reuse/recycle has been determined to be available and demonstrated because it is practiced at facilities generating K002, K003, and K006.

6. SELECTION OF REGULATED CONSTITUENTS

In the case of wastes K002, K003, and K006, EPA has chosen reuse/recycle as BDAT (see Section 5). Since there is no discharge of nonwastewater residuals from the reuse/recycle technologies employed for these treatment processes, no regulated constituents were chosen for these waste codes.

7. DEVELOPMENT OF BDAT TREATMENT STANDARDS

In the case of K002, K003, and K006 nonwastewaters, which the Agency believes can be completely reused/recycled, it is proposing a standard of "no land disposal" based on recycling.

In the case of K005 and K007, the Agency is proposing a standard of "no land disposal" based on no generation. These standards apply, however, only to wastes from current management, and not to residuals generated from historical management.

8. REFERENCES

APHA, AWWA, and WPCF. 1985. American Public Health Association, American Water Works Association, and Water Pollution Control Federation. Standard methods for the examination of water and wastewater. 16th ed. Washington, D.C.: American Public Health Association.

USEPA. 1980a. U.S. Environmental Protection Agency, Office of Solid Waste. Background document for the Resource Conservation and Recovery Act, Subtitle C - identification and listing of hazardous waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1980b. U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory. Multi-media assessment of the inorganic chemicals industry, Volume II. Cincinnati, Ohio: U.S. Environmental Protection Agency.

USEPA. 1987. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite engineering report of stabilization of wastewater treatment sludge from the production of inorganic pigments. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988a. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for F006. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988b. U.S. Environmental Protection Agency, Office of Solid Waste. Generic quality assurance project plan for Land Disposal Restrictions Program ("BDAT"). Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988c. U.S. Environmental Protection Agency, Office of Solid Waste. Methodology for developing BDAT treatment standards. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988d. U.S. Environmental Protection Agency, Office of Solid Waste. Treatment technology background document. Washington, D.C.: U.S. Environmental Protection Agency.